PEACH DISEASES III

STUDIES IN THE PREVENTION OF LEAF CURL AND SCAB
THE SEASON'S LESSONS
CAUTIONS

OHIO
Agricultural Experiment Station

WOOSTER, OHIO, U S A, FEBRUARY, 1904

BULLETIN 148

The Bulletins of this Station are sent free to all residents of the State who request them Persons who desire their address changed should give both old and new address All correspondence should be addressed to

EXPERIMENT STATION, WOOSTER, HIO

ORGANIZATION OF THE
OHIO AGRICULTURAL EXPERIMENT STATION.

BOARD OF CONTROL.

D. L. SAMPSON, *President*.....Cincinnati
T. C. LAYLIN, *Secretary*.....Norwalk
D. D. WHITE, *Treasurer*.....Castalia
ALVA AGEE.....Wooster
JOHN COURTRIGHT.....Ashville

STATION STAFF.

CHARLES E. THORNE, M. A. S.....Director
WILLIAM J. GREEN.....Horticulturist and Vice-Director
(Superintendent of Orchards, Gardens and Greenhouses.)
AUGUSTINE D. SELBY, B. Sc.....Botanist
(In charge of botanical and plant physiological and pathological investigations.)
C. G. WILLIAMS.....Agriculturist
(Superintendent of Farm.)
JOHN W. AMES, B. Sc.....Chemist
L. H. GODDARD.....Experimentalist
H. A. GOSSARD, M. S.....Entomologist
B. E. CARMICHAEL, B. S.....Animal Husbandman
WILLIAM H. KRAMER.....Bursar
CLARENCE W. WAID, B. Sc.....Assistant Horticulturist
(In charge of Greenhouses.)
F. H. BALLOU.....Assistant Horticulturist
(In charge of Orchards.)
J. S. HOUSER, B. S.....Assistant Entomologist
J. M. VAN HOOK, A. M.....Assistant Plant Pathologist
F. A. WELTON, B. S.....Assistant Chemist
M. O. BUGBY, B. S.....Assistant Experimentalist
TRUE HOUSER.....Assistant in Plant Breeding
WILLIAM HOLMES.....Farm Foreman
CHARLES A. PATTON.....Meteorological Observer
CAREY WELTY.....Mechanic
FAYE BLAYNEY.....Mailing Clerk
MARY M. LEE.....Stenographer

EDWARD MOHN.....Supt. Northeastern Test-farm, Strongsville
HENRY M. WACHTER.....Supt. Southwestern Test-farm, Germantown
LEWIS SCHULTZ.....Supt. Southeastern Test-farm, Carpenter

The Bulletins of this Sta ion are issued at irregular intervals. They are paged consectutively and an index is included with the Annual Report, which consitutes the final number of each yearly volume.

BULLETIN

OF THE

Ohio Agricultural Experiment Station

NUMBER 148. FEBRUARY, 1904.

PEACH DISEASES III.

BY A. D. SELBY.

The present brief notes upon peach diseases are a continuation of results previously published by the writer. The two former bulletins, No. 92 (1898), "Preliminary Report Upon Diseases of the Peach—Experiments in Spraying Peach Trees," and No. 104 (1899), "Further Studies Upon Spraying Peach Trees and Upon Diseases of the Peach," will explain the title of "Peach Diseases III."

The conditions surrounding outbreaks of peach leaf curl and peach scab as well, are such that advance preparation and systematic experimentation are not easy to plan. It may be recalled that the writer's earlier work in spraying for leaf curl, which was begun in 1895 while the ravages of the serious curl outbreaks of 1893 could still be observed upon the trees, must of necessity be continued until 1898 before a possible fruit crop and accompanying leaf curl conditions were met together in the same year. Admitting that any limited term of years is too brief to continue experiments in the treatment of growing plants, if all doubtful factors are merged into the results, it is yet clear that such uncertainty as to conditions for a favorable or decisive outcome make the reasons for continuous experiments away from the Experiment Station grounds, at briefest, less insistent.

No apology is required under such circumstances for this collection of notes gleaned from the results of diverse spraying operations, only part of which were planned and carried forward with the purpose to which they are now made tribute. These statements apply in almost equal measure to the scab which attacks the fruit of the peach. If we plan in advance solely, the conditions which result in scab prevalence may pass the counsels meet for them; results must be gleaned when they may.

PEACH LEAF CURL.

This foliage disease of the peach has already been described in one of the other bulletins cited. (Bulletin 92 pp. 226-230) We note now simply that the marked deformation and usually lighter color of the leaves are due to a minute parasitic plant known as the leaf curl fungus, *Exoascus deformans* B. As a result of the rapid multiplication and development of this fungus, which is favored by the conditions of the weather and the susceptibility of the variety to be further considered, the leaf tissues are penetrated and we have a great variety in the distortion and color effects on the leaves that are attacked. This in itself is much less serious than the further fact that these diseased leaves do not do the work required of leaves for the benefit of the plant; that they soon drop as a result of the attack of the fungus and that the fruit also drops in cases of severe attack because of the impaired vigor of the tree from these causes.

It has been shown that the leaf curl fungus passes the winter, or hibernates, within the bud scales of the tree. While it has been noticeable that some orchards of varieties elsewhere susceptible to leaf curl are at times free from attack, this appears to be attributable to the absence of the infection by the fungus; in the peach growing districts of the state it is clear that the infection is very general and this appears to follow in most nurseries. It would be more difficult to explain why the fungus does not extend to some less susceptible varieties than to trace the source of infection. Nevertheless, it is apparent that the absence of possible infection can scarcely be urged as sufficient explanation for the absence of the disease upon trees of a given variety. Assuming orchards infected with the leaf curl fungus, the prevalence, or comparative absence of leaf curl in a given area, will be influenced by the results of prevailing favorable or unfavorable conditions for the development of this fungus.

CONDITIONS FAVORING LEAF CURL OUTBREAKS.

The writer has mentioned the apparent connection between the weather of April, May and June and leaf curl prevalence in the earlier bulletin (Bulletin 92: 228-229) and in a paper presented, by request, before the Society for the Promotion of Agricultural Science, in 1899.*

TABLE I.—SHOWING MEAN TEMPERATURES, NUMBER OF RAINY DAYS AND TOTAL RAINFALL AT SANDUSKY, OHIO, FOR THE MONTHS OF APRIL, MAY AND JUNE FOR THE YEARS 1893 TO 1903, INCLUSIVE. ALSO ASSOCIATED LEAF CURL CONDITIONS UPON SUSCEPTIBLE VARIETIES OF PEACHES IN THE ADJACENT PENINSULAR DISTRICT OF OTTAWA COUNTY.

Year and Month.	Normal Temperature	Mean Temperature Degrees	Number of Rainy days	Total Rainfall Inches	Normal Rainfall	Leaf-Curl Condition
1893 April	47	46.8	19	4.95	2.63	Very bad
1893 May	58	55.8	14	2.96	4.39	" "
1893 June	69	71.	14	.91	3.89	" "
Totals and Averages	**58**	**57.9**	**47**	**8.82**	**10.89**	
1894 April		48.2	14	1.67		
1894 May		58.4	21	3.64		
1894 June		71.1	13	3.22		
Totals and Averages		**59.2**	**48**	**8.53**		
1895 April		48.8	11	2.25		None
1895 May		60.5	9	2.00		"
1895 June		71.5	12	1.61		"
Totals and Averages		**60.3**	**32**	**5.86**		
1896 April		53.8	15	4.12		Little
1896 May		66.2	14	1.67		"
1896 June		69.2	12	2.94		
Totals and Averages		**63.1**	**41**	**8.73**		
1897 April		47.2	18	2.11		Bad
1897 May		56.6	17	3.84		"
1897 June		66.9	13	2.04		
Totals and Averages		**56.8**	**48**	**7.99**		
1898 April		46.1	15	1.95		Very bad
1898 Map		60.2	19	2.73		" "
1898 June		70.9	14	5.11		Bad
Totals and Averages		**59.1**	**48**	**9.79**		
1899 April		50.2	13	1.02		None
1899 May		61 4	20	4 32		"
1899 June		70.4	13	3.46		"
Totals and Averages		**60.1**	**46**	**8.80**		
1900 April		48.0	14	1.80		Bad
1900 May		63 4	14	2 23		"
1900 June		68.7	14	3.60		
Totals and Avsrages		**60.0**	**42**	**7.63**		
1901 April		45 4	16	1 84		Bad
1901 May		57.0	21	3 19		"
1901 June		68.8	16	3 81		
Totals and Averages		**57.1**	**53**	**8.84**		
1902 April		46.8	19	1.42		Began with vigor
1902 May		59.2	15	4.01		Reduced with
1902 June		65.6	23	8.85		warmth
Totals and Averages		**57.2**	**57**	**14.28**		
1903 April	47.0	48.4	15	3.96	2.71	Very bad
1903 May	58 5	61.6	8	1.43	3.70	" "
1903 June	69 0	63.6	21	3.79	3.83	" "
Totals and Averages	**58.2**	**57.9**	**44**	**9.18**	**10.24**	

*Variations in the amount of leaf curl of the peach (*Exoascus deformans B.*) in the light of weather conditions. Proc. S. P. A. S. 20: 98-104. (1899.)

In the years 1893, 1897, 1898, 1900, 1901, 1902 and 1903 we have had specific outbreaks of leaf curl in the peninsula orchards of Ottawa county. In other seasons, as in 1895, 1896 and 1899 we have had very much less of the disease. From the summary of the meteorological conditions given in Bulletin 92 for the years '93-'95-'96 and '97, it has appeared to the writer that these offer an approximate explanation of the marked variation observed. The earlier records have been summarized and to them have been added likewise a summary of the conditions prevailing in the years since '97 for the months of April, May and June. (Table I.) I believe these will offer a useful though but partial explanation of the variation in the amount of leaf curl observed on susceptible peach sorts in the region devoted to peaches. By a study of this table the low mean temperatures and frequent rains for the month of April upon "curl" years will stand out. It will likewise be observed that the temperature and rainfall conditions of May and June, exercise a very marked influence upon the continuation or continued prevalence of the leaf curl during these months. For the past season, 1903, attention is called to the relatively low temperature for June. May we not be assured that in the cool weather and frequent rains of April we have an explanation of the season's outbreaks; and particularly in the June conditions of the continuance of the leaf curl virulence and its attack upon the later leaves so observable into June of 1903?

It must be admitted that all the factors are difficult to include in a table. The amount of previous infection is one of such factors; this appeared to play little part in the year 1899 when there was scarcely any of the disease following the serious seasons of 1897 and 1898. The winter's cold of 1896-7 which killed the fruit buds was even more extreme than that of 1898-9; this would be against winter killing of the fungus in 1898-9. The total April rainfall for 1898 was very much less than for the same month in 1895 and 1896, yet the first named year was one of virulent leaf curl while the two latter years mentioned showed but very little disease. Here as in 1899 the variation appears in the temperature.

PREVENTION OF LEAF CURL BY SPRAYING.

When the writer began spraying for leaf curl in 1895 the practical effectiveness of fungicides for this disease had not been demonstrated: the results obtained in 1897 and 1898 from the continuation of the experiments in the curl off years of 1895 and 1896, gave very decided testimony as to the efficiency of Bordeaux mixture in saving the fruit crop with the foliage. Experiments made elsewhere have shown similar results with Bordeaux mixture and sim-

ilar success with copper sulfate, and incidentally with other sprays.

The successful use of lime-sulfur sprays, in the various modifications, tor checking scale insects, has brought these mixtures into the realm of successful fungicides for leaf curl and scab of the peach. In the sprays of this class whether the base is soda or lime the result of the prolonged heating with sulfur is to effect a chemical combination or various chemical combinations of the base with the sulfur and to form various sufids, hyposulfites, etc. The well known efficiency of potassium sulfid as a fungicide properly led to the expectation that these somewhat analogous compounds would prove to be useful as fungus sprays, an expectation that has been realized.

BORDEAUX MIXTURE FOR LEAF CURL.

Attention is again called to the results in leaf curl prevention in 1898, etc., by the use of Bordeaux mixture upon dormant peach trees in spring. (Bulletin No. 104: 202-210 with plates I & II.) In that year complete success in crop saving upon trees of the Elberta variety with the normal strength of spray attended applications made by Mr. William Miller, Gypsum, Ohio, on April 12th, followed by the half-strength formula May 17th; the unsprayed trees retained no fruit and had scarcely enough leaves to cast a shadow when photographed June 11, 1898. In 1900 similar success was secured from one application of Bordeaux mixture made in April by the same gentleman; my notes of May 18, 1900 estimate 85 per cent of diseased leaves on the unsprayed or check trees and but 15 per cent on the sprayed ones. I have recorded a like condition in the same orchards June 6, 1901, after a repetition of the Bordeaux spraying in the spring of 1901. The same state of facts held with other susceptible varieties of peaches upon Mr. Miller's ground for the years stated.

Other growers have duplicated the results here outlined and we may rely upon the full efficiency of Bordeaux mixture in leaf curl prevention applied on dormant trees of susceptible varieties of the peach in our Ohio peach belt. Whatever success may come to be proved for other sprays in leaf curl prevention does not imply that these are to supplant Bordeaux mixture for this purpose.

The comparative worth of the remedies found successful under different conditions can be determined only by actual experiment under like conditions. Where fungous diseases alone are to be prevented upon the peach, and this includes leaf curl, the writer still regards Bordeaux mixture as the simplest and most efficient remedy.

LIME-SULFUR-SALT SPRAY FOR LEAF CURL.

In experiments carried on under the direction of Prof. P. J. Parrott, Entomologist of this station, by Messrs. Duroy and Yule, in their orchards located near Danbury, Ottawa county, O., a good illustration is furnished of the effectivenesss of the lime-sulfur-salt spray for leaf curl in 1905. (See plates I & II.) The trees, 5 years old, of the Elberta variety, with the exception of the check trees, were sprayed once in March-April, 1903, with this spray made after the 15, 15, 15, to 50 gallon formula, after one and one-half hours heating or cooking. By the courtesy of the Entomologist and Messrs. Duroy and Yule these illustrations were made possible. The photographs were taken by the writer June 16th, 1903. At this date the treated trees had a full crown of leaves and a fine crop of fruit; this fruit came to maturity in fine condition. Upon the same date, June 16th, 1903, the check or untreated trees showed very few leaves and practically no fruit. Certainly the illustrations tell the story impressively. It is proper to remark that the conditions of June, 1903, prolonged the usual period of leaf loss from the curl.

SODA-LIME-SULFUR-VITRIOL SPRAY FOR LEAF CURL.

The next illustrations, which with those just preceding should be compared with plates I and II, Bulletin 104 (1899), give the results of a soda-lime-sulfur-vitriol spray applied upon eleven-year old Elberta peach trees by Mr. Wm. Miller, Gypsum, O. (See plates III & IV). The orchard in question is Mr. Miller's North Elberta orchard mentioned in detail in the earlier experiments. (Bulletin 92 and Bulletin 104). The spray was applied in March and April 1903; the two dates representing the applications made upon the two opposite sides of the trees with favorable wind in each case. In other portions of this same orchard, trees that received the soda-lime-sulfur spray gave like results as to leaf curl prevention and bore as fine crops of fruit, while the check or untreated trees were in all cases very badly diseased and dropped their fruit.

With the soda-lime-sulfur-vitriol and the straight lime-sulfur-salt the leaf curl prevention was entirely satisfactory and comparable with that attained in 1898 and 1900 by the use of Bordeaux mixture.

MAKING SODA-LIME-SULFUR SPRAY.

The writer was in a sense responsible for the soda modification of this spray used by Mr. Miller. Laboratory trials at the Station in the fall of 1902 had proved that a soda-sulfur mixture (compound) could be made with but very brief heating by using caustic

soda and flowers of sulfur. In these laboratory experiments, it was found that the heat of the aqueous solution, generated when water in limited quantities was added to the caustic soda, was enough to cause the sulfur to enter into combination with the soda base, upon subsequent addition of this sulfur by stirring. Only a brief application of external heat was indicated as necessary for commercial operations where caustic soda is employed to replace the lime entirely or in part. Mr. Miller found that by the use of about one fourth as much soda as that specified in the customary formula for the lime, the combination with the sulfur was accelerated and only half an hour's or even twenty minutes' heating sufficed, after the addition of all the required lime, sulfur, etc., to bring the whole mass to a uniform, brick red color. His results, in so far as leaf curl and scab of the peach and scab of the apple are concerned, indicate that he prepared in this manner an effective fungicide. I believe the copper sulfate (blue vitriol) was added after the dilution of the heated mixture. The following is the formula as furnished by Mr. Miller:—

	In 300 Gallons	In 50 Gallons
Soda	30 lbs	5 lbs
Lime	120 lbs	20 lbs
Sulfur	60 lbs	10 lbs
Vitriol	15 lbs	2½ lbs
Water	300 gals	50 gals

The suggestion as to the use of caustic soda instead of part of the lime of the normal lime-sulfur spray was incorporated in the spray calendar and may have been tried by other persons. Naturally it is proper to observe that this discussion is not intended to cover applications for scale destruction.

PREVENTION OF PEACH SCAB.

In 1895 and 1896 certain experiments were made in the orchards of Mr. William Miller, Gypsum, Ohio, in spraying the Salway variety of peach to prevent the brown spot or scab, a fungous disease to which this valuable variety is susceptible. The scab is due to the fungus, *Cladosporium corpophilum* Thuem., which produces in its earlier stages of growth, more or less disconnected brown or nearly black spots; later these spots may become confluent, especially over one entire side of the peach, and often result in the hardening and cracking of this diseased portion. The Salway variety is a very productive and profitable late variety in our peninsula and island peach district, so that the control of the fungus is an important factor in successful peach growing.

In the years before named, in Mr. Miller's North Salway orchard the two years' successive treatments reduced the number of scabbed peaches from 27.7 per cent to 2.95 per cent while a single year's spraying did not reduce the scab appreciably. (See Bulletin 92, p. 252.)

TABLE II.—SHOWING MEAN TEMPERATURES, NUMBER OF RAINY DAYS AND TOTAL RAINFALL AT SANDUSKY, O , FOR THE MONTHS OF JULY, AUGUST, SEPTEMBER AND OCTOBER 1 TO 10, FROM 1893 TO 1903 INCLUSIVE. ALSO ASSOCIATED SCAB CONDITIONS ON SUSCEPTABSE VARIETIÉS OF PEACHES IN ADJACENT PENINSULAR DISTRICT OF OTTAWA COUNTY.

Year and Month.	Normal Temperature	Mean Temperature Degrees	Number of rainy days	Total Rainfall Inches	Normal Rainfall	Scab Conditions
1893 July	74	74 5	10	3 35	3 20	
1893 August	71	71 2	8	1 13	2 78	
1893 September	65	65 0	11	93	3 17	
1893 October 1-10th		60 9	3	1 23		
Totals and Averages	67 9	67 9	32	6 64	9 17	
1894 July		75 3	7	2 84		
1894 August		70 8	5	23		
1894 September		67 6	13	3 49		
1894 October 1-10th		54 1	7	1 90		
Totals and Averages		66 9	32	8 46		
1895 July		71 7	8	1 48		
1895 August		72 9	15	3 32		
1895 September		68 8	9	2 23		
1895 October 1-10th		52 1	2	04		
Totals and Averages		66 9	34	7 07		
1896 July		73 5	15	5 55		
1896 August		72 2	10	2 71		Bad
1896 September		62 2	12	4 52		Bad
1896 October 1-10th		49 6	2	48		
Totals and Averages		64 4	39	13 26		
1897 July		75.5	16	4 29		
1897 August		69 4	14	2 50		
1897 September		67 4	3	91		
1897 October 1-10th		59 4	2	03		
Totals and Averages		67 9	35	7 73		
1898 July		74 9	13	5 69		
1898 August		73 3	16	5 25		
1898 September		68 2	13	2 09		
1898 October 1-10th		64 9	4	2 34		
Totals and Averages		70 3	46	15 37		
1899 July		73 6	15	3 44		
1899 August		73 4	6	2 74		
1899 September		62 8	17	1 07		
1899 October 1-10th		54 1	4	12		
Totals and Averages		65 9	42	7 37		
1900 July		73 7	16	7 58		
1900 August		76 2	14	4 91		
1900 September		65 5	11	1 50		
1900 October 1-10th		62 5	2	73		
Totals and Averages		70 3	43	14 72		
1901 July		78 4	13	1 48		
1901 August		73 2	12	3 93		
1901 September		65 8	13	1 01		
1901 October 1-10th		54 9	5	30		
Totals and Averages		68 1	43	6 72		
1902 July		74 4	17	5 33		
1902 August		69 0	13	1 23		
1902 September		63 6	19	6 20		
1902 October 1-10th		59 1	6	69		Very bad
Totals and Averages		66 5	55	13 95		" "
1903 July	73 1	73 0	13	4 45	3 75	
1903 August	71	69 3	17	6 32	2 76	
1903 September	65 1	65 8	8	1 27	2 99	Bad
1903 October 1-10th		62 1	7	1 87		"
Totals and Averages	69 7	67 5	45	13 91	9 50	

Scab prevalence appears to be influenced very strikingly by the weather conditions of late summer and early fall, but more especially as to cracking open and attendant rotting by the weather of September and early October. These conditions at Sandusky, O., have been tabulated and are given herewith in Table II.

The table shows very heavy rainfall and conditions favorable to scab development in 1896; the same was true in a marked degree in 1902 and the condition reached the fungus covered though not the cracking and rotting stages in 1903. The season of 1903 well illustrates the saving grace of fine sunny weather even after all preceding conditions had marked the peaches of the Salway variety for destruction.

The losses from cracking and rotting of this variety (Salway) in the vicinity of Gypsum and Catawba Island in 1902 were enormous. The total losses in a comparatively limited, central area of our peach regions, viz., that tributary to Gypsum, must have reached from 30,000 to 50,000 bushels, or one third the total crop of the late varieties. The remaining two thirds of the crop was reduced in value by the spotting and imperfect development resulting from the attacks of the fungus. The conditions of 1902 made scab prevention of first importance to growers of the Salway variety for 1903. The writer has accordingly followed the matter with some care for the season of 1903 and presents the following notes:

SPRAYING FOR SCAB IN 1903.

The experiments which are recorded below were all upon the Salway variety. In the orchards under experiment the fruit had been badly affected in 1902, and in the Danbury orchard of Duroy and Yule little or no crop was saved.

In this latter orchard I am indebted to Mr. W. C. Yule for his kindly co-operation. Two orchards or blocks of Salway are considered. One of these, the west orchard or No. 1 had been injured in places by San José scale in 1902, while scab had been general and the fruit was chiefly lost by cracking and subsequent rotting.

To begin with, this entire orchard, No. 1, was sprayed with lime-sulfur-salt mixture in March, 1903, under the direction of the Station Entomologist, this treatment resulted in checking scale injuries and in normal growth and vigor. As noted for leaf curl, this spray is sufficient as a first application on dormant trees for fungous diseases including scab. Following this spray different portions of the orchard were treated differently in foliage; the portion sprayed once, July 2, 1903, with half strength Bordeaux mixture, (Bordeaux II of calendar), was photographed in fruit Sept. 30,

1903. (See plate V.) The scab prevention was very satisfactory on this part; no fruit cracking and very little dark spotting, while the foliage was in prime condition.

The areas near this, unsprayed in foliage, showed an appreciable amount of cracking and rotting, and the fruit was of impaired appearance. (See plate VI.) No trees were left here without the earlier treatment with the lime-sulfur-salt spray.

Another part of orchard No. 1 was sprayed once with lime-sulfur 1:1:50 gallons July 3-6, 1903, and yet another with soda-sulfur 1:1:50 gallons on same date. Neither of these gave as satifactory scab prevention as the treatment with Bordeaux II above noted while better than those untreated in foliage; trees treated with these sulfid sprays showed much more cracking from scab and rotting than where the Bordeaux was applied. The foliage injuries from the sulfid sprays were slight, differing very little in this from the other spray.

Upon Salway orchard No. 4, trees 7 or 8 years old, belonging to the same gentlemen, no early spring treatment was applied in 1903; in 1902 the entire crop of fruit had been lost from scab-crack and rot. This was sprayed with Bordeaux II June 18 to 19, 1903, and again about July 1, 1903. In spite of the fact that this orchard suffered severely from leaf curl for one of this variety, and had such a scab record for 1902, Mr. Yule was able by these two treatments with the weak Bordeaux mixture, in foliage, to save a fair crop of very fine fruit. (See plate VII.) There had been some dropping of fruit by reason of leaf curl injury to foliage, but the crop was nearly as large as the trees should bear; the color and uniform size of the fruit were conspicuous for even the season of 1903. There were occasional, though very rare, marks of spray injury upon the fruit, as noted in the description of plate VII, but neither this nor the slight foliage injury would be apparent to the casual observer.

Another experience to be noted is that of Mr. Wm. Miller, Gypsum, Ottawa county. In 1902 his North Salway orchard was sprayed in March-April with soda-lime-sulfur and most of it once in early foliage, June, with Bordeaux II. A careful examination of the trees made by the writer on July 3, 1903 showed the fruit almost entirely free from scab spots; even those trees receiving only the early treatment were comparatively free from scab at that date. Indeed, I advised Mr. Miller that further spraying seemed unnecessary; but in this I was proved in error. The month of August, 1903, was a very rainy one, with double the normal rainfall and many rainy days, 17 in all. Evidently the sprayings made had been

too early to meet these conditions, for on August 13, 1903, when next visited, the fruit was conspicuously scab-spotted on all the rows of the orchard examined, though but few confluent spots were visible. September 30, when nearly ready for market the orchard was again visited. A considerable proportion of the fruit on these Salway trees was marked with scab spots, while there was little crack and rot. Judging by the results at Danbury, an additional treatment with Bordeaux mixture II would have been very effective on these trees.

Mr. Bert Lockwood, also of Gypsum, has been spraying for scab, having succeeded by one spraying on dormant trees and one of weak Bordeaux upon the trees in foliage, in saving his Salway and Smock fruit from crack and rot in 1902. Still there was a good deal of spotting on this fruit. Upon the trees so treated in 1903, of the varieties Smock, Lemon Free and Salway there was evident spotting though very little cracking.

CONCLUSIONS AS TO SCAB SPRAYING IN 1903.

From the foregoing cases and from the earlier study already published, it appears to me that we must recognize the efficacy of later applications of weak Bordeaux mixture upon peach trees in foliage to prevent scab. While it is clear that two applications, one on the dormant trees and one in foliage, will usually save the crop of the late varieties susceptible to scab, from the cracking and therefore from its attendant rotting, it is not apparent that this is sufficient. In the case at Danbury upon Salway orchard No. 1 to the relatively late date of the application of Bordeaux II we may attribute, in part, the better success of the two treatments.

The earlier foliage spraying, (it was done before June 15), upon Salway's at Mr. Miller's, Gypsum, was not sufficient when following the early spray. It appears that a second spraying before the middle of July, or as late as could be made with safety and escape marking fruit by the spray, would have been very profitable.

The entirely satisfactory two-treatment spraying in foilage upon Salway orchard No. 4. by Mr. Yule appears to owe its effectiveness in part to the later date of these applications. There is a possibility that conditions are slightly more favorable to the spread of scab in one of these orchards than in the other, yet this can scarcely explain the whole difference.

I can find nothing in the season's results to indicate that we may omit spraying in foliage on the peach for scab, with Bor-

deaux mixture II, on the other hand there seems sufficient evidence to warrant the recommendation to spray once on dormant trees and twice in foliage for this disease. The earlier of the spraying, in foliage may apparently be made to good advantage about June 15, the second foliage spray two or three or even four weeks later than the first. Both sprayings in foliage should be of the half strength, while the earlier or dormant treatment may be of Bordeaux full strength or of one of the sulfur sprays.

SUMMARY

This bulletin contains a series of notes upon the prevalence, surrounding conditions and methods of prevention of leaf curl and scab of the peach during recent years in Ohio.

It recites the facts concerning a series of leaf curl outbreaks for the past eleven years in northern Ohio and endeavors to set forth the correlated weather conditions with respect to temperature and rainfall.

The leaf curl prevalence noted herein has been associated with low temperatures and frequent rainy days during April, May and June. When these months had been warm and fairly bright the amount of leaf curl has been reduced to almost nothing; note the examples of 1895, 1896 and 1899.

One spraying with Bordeaux mixture in the spring, before the opening of the blossoms, continues to prove effective in the prevention of leaf curl. Lime-sulfur-salt spray, soda-lime-sulfur and soda-lime-sulfur-vitriol sprays have likewise proved efficient preventives of leaf curl. Where fungous diseases only are to be combatted the Bordeaux mixture is preferred; where scale insects are present the sulfur sprays may be relied upon for leaf curl prevention.

In the light of eight years' experience in leaf curl prevention in northern Ohio, orchardists are again warned that the neglect of spray treatment each year upon susceptible varieties of the peach, notably the Elberta, is liable to be followed by total loss of crop and injury to trees by leaf curl attack.

Seven years' study of the prevalence and injuries of the fruit spot or scab fungus, confirms the popular opinion that this fungus is influenced in its developement by the amount of rainy weather during the late summer and early fall.

The losses from the cracking and subsequent rotting induced by the attacks of the scab fungus were very large about Gypsum in the fall of 1902. The earlier judgment that these losses may be largely or entirely prevented by spraying in foliage is again confirmed.

For scab prevention, in addition to one spraying before blossoming with some effective fungicide, recent observations indicate the need of two applications of weak Bordeaux mixture upon the trees in foliage; the earlier of these to be made in northern Ohio about June 15th; the second, three to four weeks later.

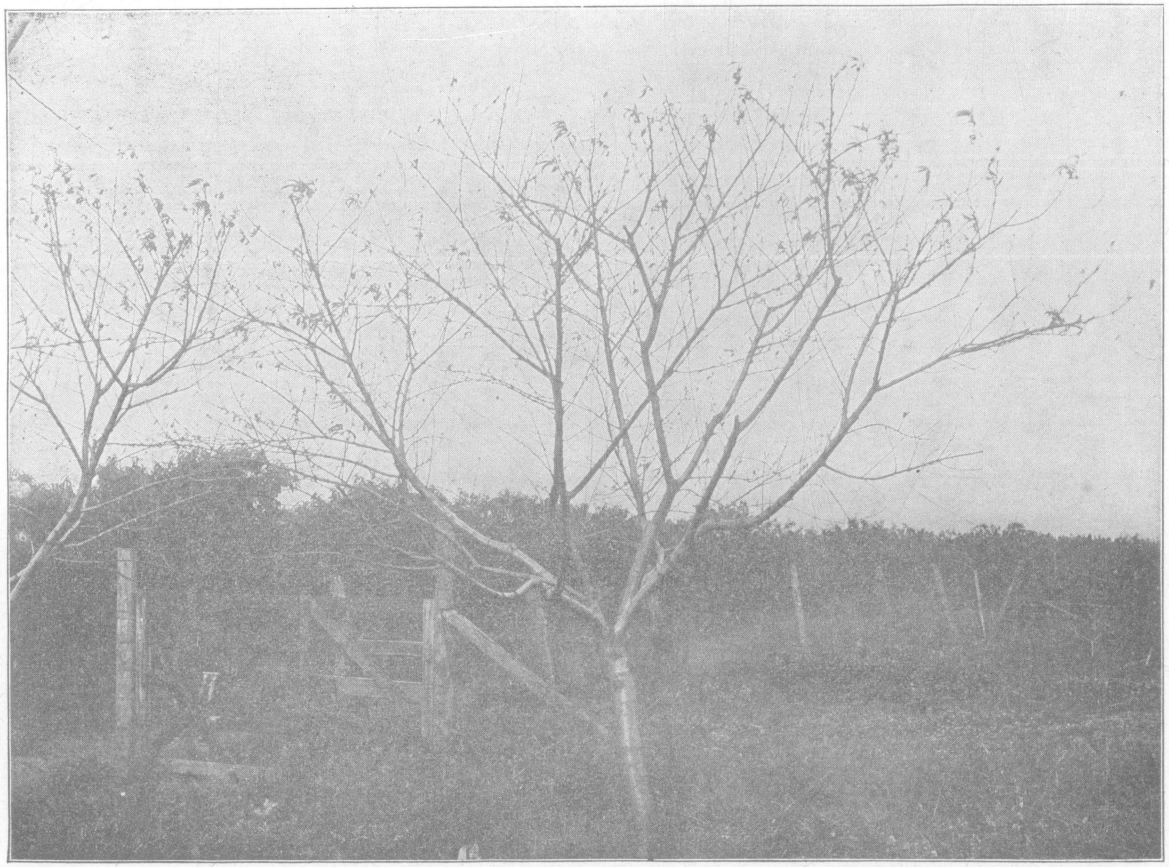

PLATE I—Five-year-old Elberta peach tree unsprayed, defoliated by leaf curl. Orchard of Duroy & Yule. Photographed June 16, 1903.

PLATE II—Five-year-old Elberta peach tree, sprayed with lime-sulfur-salt, April, 1903, under direction of P. J. Parrott. Foliage and fruit saved by this treatment. Orchard of Duroy & Yule, Danbury, Ohio. Photographed June 16, 1903.

PLATE III—Eleven-year-old Elberta peach tree, unsprayed, defoliated by leaf curl. No fruit. North orchard of Wm. Miller, Gypsum, Ohio. Photographed June 16, 1903.

PLATE IV—Eleven-year-old Elberta peach tree, sprayed March and April, 1903, with soda-lime-sulfur-vitriol, under direction of the owner. Foliage and fruit crop saved by the treatment. North orchard of Wm. Miller, Gypsum, O. Photographed June 16, 1903.

PLATE V—Southwest corner Salway orchard No. 1, Duroy & Yule, Dunbury, sprayed July 2, 190?, with half strength Bordeaux mixture, following lime-sulfur-salt. Both fruit and foliage fine on this section. Photographed Sept. 3?, 190?.

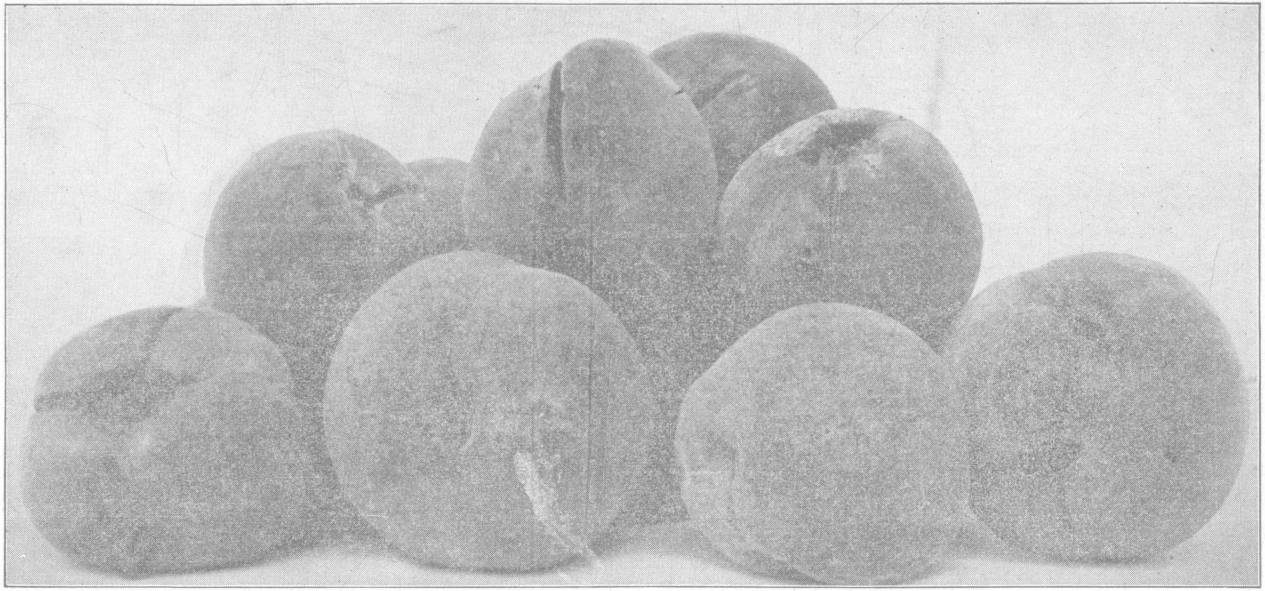

PLATE VI—Salway peaches shrunken and cracked from scab; also showing secondary rotting. The dark aspect due to scab fungus is not here reproduced. From portion of same orchard as Plate V, but unsprayed in foliage. Photographed Oct. 2, 1903.

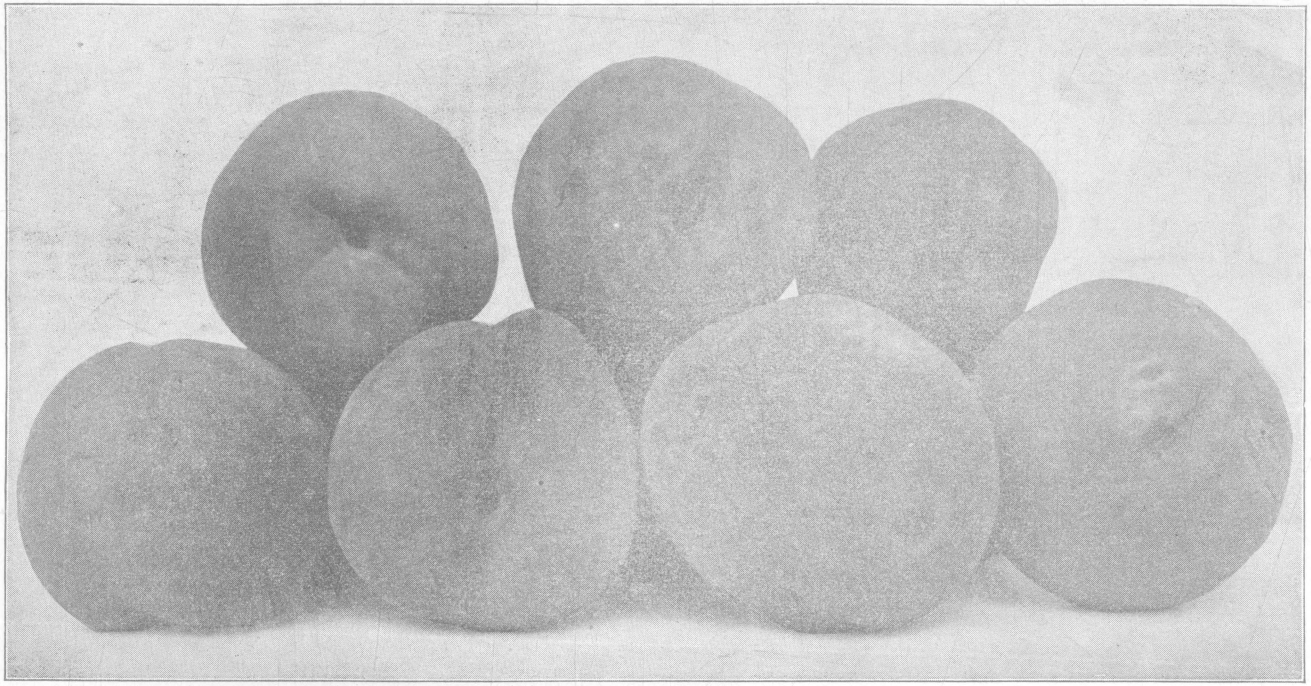

PLATE VII—Salway peaches sprayed to prevent scab. A portion of these from orchard No. 1, Duroy & Yule, receiving lime-sulfur-salt and Bordeaux II. The others from orchard No. 4, Duroy & Yule, sprayed twice in foliage with Bordeaux II. The extreme lower left-hand specimen shows slight marking by the Bordeaux mixture—the bruises shown on all due to packing. Photographed Oct. 2, 1903.

This page intentionally blank.